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## EdgeWrite: a stylus-based text entry method designed for high accuracy and stability of motion

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### ↑ ABSTRACT

EdgeWrite is a new unistroke text entry method for handheld devices designed to provide high accuracy and stability of motion for people with motor impairments. It is also effective for able-bodied people. An EdgeWrite user enters text by traversing the edges and diagonals of a square hole imposed over the usual text input area. Gesture recognition is accomplished not through pattern recognition but through the sequence of corners that are hit. This means that the full stroke path is unimportant and recognition is highly deterministic, enabling better accuracy than other gestural alphabets such as Graffiti. A study of able-bodied users showed subjects with no prior experience were 18% more accurate during text entry with Edge Write than with Graffiti ( $p > .05$ ), with no significant difference in speed. A study of 4 subjects with motor impairments revealed that some of them were unable to do Graffiti, but all of them could do Edge Write. Those who could do both






methods had dramatically better accuracy with Edge Write.

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## ↑ INDEX TERMS

### Primary Classification:

**C. Computer Systems Organization**

↳ **C.5 COMPUTER SYSTEM IMPLEMENTATION**

↳ **C.5.3 Microcomputers**

↳ **Nouns: Palm**

### Additional Classification:

**D. Software**

↳ **D.4 OPERATING SYSTEMS**

↳ **D.4.3 File Systems Management**

↳ **Subjects: Access methods**

**H. Information Systems**

↳ **H.5 INFORMATION INTERFACES AND PRESENTATION (I.7)**

↳ **H.5.2 User Interfaces (D.2.2, H.1.2, I.3.6)**

↳ **Subjects: Screen design (e.g., text, graphics, color)**

**I. Computing Methodologies**

↳ **I.5 PATTERN RECOGNITION**

↳ **I.5.0 General**

**General Terms:**Design, Management**Keywords:**PDAs, assistive technology, computer access, corners, edges, gesture recognition, graffiti, handhelds, motor impairments, palm, pebbles, text entry, text input, unistrokes↑ **REVIEW**"J. Wolper"

A recent issue of *The Economist* claims that the market for personal digital assistants (PDAs) is waning, but personal observation (for example, my physician running from the examining room to fetch his PDA-based drug reference) casts some d more...

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### 1 [An alternative to push, press, and tap-tap-tap: gesturing on an isometric joystick for mobile phone text entry](#)



Jacob O. Wobbrock, Duen Horng Chau, Brad A. Myers

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A gestural text entry method for mobile is presented. Unlike most mobile phone text entry methods, which rely on repeatedly pressing buttons, our gestural method uses an isometric joystick and the EdgeWrite alphabet to allow users to write by making ...

**Keywords:** EdgeWrite, T9, gestures, isometric joysticks, mobile phones, multitap, pointing, smartphones, text input, unistrokes

### 2 [Text entry from power wheelchairs: edgewrite for joysticks and touchpads](#)



Jacob O. Wobbrock, Brad A. Myers, Htet Htet Aung, Edmund F. LoPresti

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**Publisher:** ACMFull text available: [pdf\(1.07 MB\)](#)
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Power wheelchair joysticks have been used to control a mouse cursor on desktop computers, but they offer no integrated text entry solution, confining users to point-and-click or point-and-dwell with on-screen keyboards. But on-screen keyboards reduce ...

**Keywords:** computer access, edge wite, gestures, joystick, pebbles, power wheelchair, text entry, text input, touchpad, unistrokes

### 3 [Text entry from power wheelchairs: edgewrite for joysticks and touchpads](#)



Jacob O. Wobbrock, Brad A. Myers, Htet Htet Aung, Edmund F. LoPresti

 October 2004 **Assets '04: Proceedings of the 6th international ACM SIGACCESS conference on Computers and accessibility**
**Publisher:** ACMFull text available: [pdf\(1.07 MB\)](#)
 Additional Information: [full citation](#), [abstract](#), [references](#), [cited by](#), [index terms](#)

Power wheelchair joysticks have been used to control a mouse cursor on desktop computers,

but they offer no integrated text entry solution, confining users to point-and-click or point-and-dwell with on-screen keyboards. But on-screen keyboards reduce ...

**Keywords:** computer access, edge wite, gestures, joystick, pebbles, power wheelchair, text entry, text input, touchpad, unistrokes

#### 4 A robust design for accessible text entry



Jacob O. Wobbrock

January 2006 **ACM SIGACCESS Accessibility and Computing**, Issue 84

**Publisher:** ACM

Full text available: [pdf\(74.76 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

This paper describes the author's dissertation research on designing, implementing, and evaluating the Edge Write text entry method. The goal of this research is to develop a method that is highly "robust," remaining accessible and accurate across a ...

#### 5 From letters to words: efficient stroke-based word completion for trackball text entry



Jacob O. Wobbrock, Brad A. Myers

October 2006 **Assets '06: Proceedings of the 8th international ACM SIGACCESS conference on Computers and accessibility**

**Publisher:** ACM

Full text available: [pdf\(535.35 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

We present a major extension to our previous work on *Trackball EdgeWrite*--a unistroke text entry method for trackballs--by taking it from a character-level technique to a word-level one. Our design is called *stroke-based word completion*, ...

**Keywords:** EdgeWrite, Fitts' law, Hick-Hyman law, WiViK, Zipf's law, gestures, goal crossing, steering law, text input, trackballs, unistrokes, word prediction and completion, word-level text entry

#### 6 Barrier pointing: using physical edges to assist target acquisition on mobile device touch screens



Jon Froehlich, Jacob O. Wobbrock, Shaun K. Kane

October 2007 **Assets '07: Proceedings of the 9th international ACM SIGACCESS conference on Computers and accessibility**

**Publisher:** ACM

Full text available: [pdf\(839.97 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Mobile phones and personal digital assistants (PDAs) are incredibly popular pervasive technologies. Many of these devices contain touch screens, which can present problems for users with motor impairments due to small targets and their reliance on tapping ...


**Keywords:** PDAs, accessible interfaces, corners, edges, mobile phones, motor impairments, target acquisition, touch screens

#### 7 Analyzing the input stream for character- level errors in unconstrained text entry evaluations



Jacob O. Wobbrock, Brad A. Myers

December 2006 **ACM Transactions on Computer-Human Interaction (TOCHI)**, Volume 13  
Issue 4


**Publisher:** ACMFull text available:  [pdf\(1.39 MB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Recent improvements in text entry error rate measurement have enabled the running of text entry experiments in which subjects are free to correct errors (or not) as they transcribe a presented string. In these "unconstrained" experiments, ...

**Keywords:** EdgeWrite, Text entry, character recognition, confusion matrix, deletion, error rate, gesture, input stream, insertion, minimum string distance, nonrecognition, omission, optimal alignment, presented string, recognizer, stream alignment, stroke, substitution, text input, transcribed string

**8** Trackball text entry for people with motor impairments

Jacob Wobbrock, Brad Myers

April 2006 **CHI '06:** Proceedings of the SIGCHI conference on Human Factors in computing systems**Publisher:** ACMFull text available:  [pdf\(1.69 MB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [cited by](#), [index terms](#)

We present a new gestural text entry method for trackballs. The method uses the mouse cursor and relies on crossing instead of pointing. A user writes in fluid Roman-like unistrokes by ""pulsing"" the trackball in desired letter patterns. We examine ...

**Keywords:** EdgeWrite, Fitts' Law, Steering Law, crossing, gestures, pointing, text entry, text input, trackballs, unistrokes

**9** In-stroke word completion

Jacob O. Wobbrock, Brad A. Myers, Duen Horng Chau

October 2006 **UIST '06:** Proceedings of the 19th annual ACM symposium on User interface software and technology**Publisher:** ACMFull text available:  [pdf\(757.99 KB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [cited by](#), [index terms](#)

We present the design and implementation of a word-level stroking system called *Fisch*, which is intended to improve the speed of character-level unistrokes. Importantly, Fisch does not alter the way in which character-level unistrokes are made, ...

**Keywords:** EdgeWrite, isometric joystick, stylus, text entry, text input, trackball, unistrokes, word completion, word prediction

**10** Gestural text entry on multiple devices

Jacob O. Wobbrock, Brad A. Myers

October 2005 **Assets '05:** Proceedings of the 7th international ACM SIGACCESS conference on Computers and accessibility**Publisher:** ACMFull text available:  [pdf\(739.49 KB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [cited by](#), [index terms](#)

We present various adaptations of the EdgeWrite unistroke text entry method that work on multiple computer input devices: styluses, touchpads, displacement and isometric joysticks, four keys or buttons, and trackballs. We argue that consistent, flexible, ...


**Keywords:** EdgeWrite, PDA, accessibility, isometric joystick, text entry, text input, trackball, ubiquitous computing, unistroke

11 Writing with a joystick: a comparison of date stamp, selection keyboard, and EdgeWrite

Jacob O. Wobbrock, Brad A. Myers, Htet Htet Aung

May 2004 **GI '04:** Proceedings of Graphics Interface 2004

**Publisher:** Canadian Human-Computer Communications Society

Full text available:  [pdf\(332.37 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [cited by](#)

A joystick text entry method for game controllers and mobile phones would be valuable, since these devices often have joysticks but no conventional keyboards. But prevalent joystick text entry methods are slow because they are selection-based. EdgeWrite, ...

**Keywords:** corners, game console, game controller, gestures, joystick, physical edges, text entry, text input, unistrokes

12 Eyes on the road, hands on the wheel: thumb-based interaction techniques for input on steering wheels



Iván E. González, Jacob O. Wobbrock, Duen Horng Chau, Andrew Faulring, Brad A. Myers

May 2007 **GI '07:** Proceedings of Graphics Interface 2007

**Publisher:** ACM

Full text available:  [pdf\(1.64 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

The increasing quantity and complexity of in-vehicle systems creates a demand for user interfaces which are suited to driving. The steering wheel is a common location for the placement of buttons to control navigation, entertainment, and environmental ...

**Keywords:** StampPad, distraction, driving, gestures, interaction techniques, selection techniques, steering, text entry, text input, thumb-based input, touchpad

13 A comparison of area pointing and goal crossing for people with and without motor impairments



Jacob O. Wobbrock, Krzysztof Z. Gajos

October 2007 **Assets '07:** Proceedings of the 9th International ACM SIGACCESS conference on Computers and accessibility

**Publisher:** ACM

Full text available:  [pdf\(1.25 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Prior work has highlighted the challenges faced by people with motor impairments when trying to acquire on-screen targets using a mouse or trackball. Two reasons for this are the difficulty of positioning the mouse cursor within a confined area, and ...

**Keywords:** Fitts' law, area pointing, goal crossing, mouse, steering law, target acquisition, throughput, trackball

14 EdgeWrite: a stylus-based text entry method designed for high accuracy and stability of motion






Jacob O. Wobbrock, Brad A. Myers, John A. Kembel

November 2003 **UIST '03:** Proceedings of the 16th annual ACM symposium on User interface software and technology

**Publisher:** ACM

Additional Information:


Full text available:  [pdf\(587.04 KB\)](#)  [wmv\(5:27 MIN\)](#)  [mov\(5:27 MIN\)](#)


[full citation](#),  
[abstract](#),  
[references](#), [cited by](#), [index terms](#),  
[review](#)

EdgeWrite is a new unistroke text entry method for handheld devices designed to provide high accuracy and stability of motion for people with motor impairments. It is also effective for able-bodied people. An EdgeWrite user enters text by traversing ...

**Keywords:** PDAs, assistive technology, computer access, corners, edges, gesture recognition, graffiti, handhelds, motor impairments, palm, pebbles, text entry, text input, unistrokes

### 15 Integrating isometric joysticks into mobile phones for text entry


 Duen Horng Chau, Jacob O. Wobbrock, Brad A. Myers, Brandon Rothrock  
April 2006 **CHI '06:** CHI '06 extended abstracts on Human factors in computing systems  
**Publisher:** ACM


Full text available:  [pdf\(528.60 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [cited by](#), [index terms](#)

We are investigating a new gestural text entry method for mobile phones that uses an isometric joystick and therefore consumes very little physical space. We have created a high-fidelity mobile phone prototype with two embedded isometric joysticks, one ...

**Keywords:** EdgeWrite, Pebbles, cell phones, crossing, gestures, isometric joysticks, mobile phones, pointing, text entry, text input, unistrokes

### 16 Maximizing the guessability of symbolic input


 Jacob O. Wobbrock, Htet Htet Aung, Brandon Rothrock, Brad A. Myers  
April 2005 **CHI '05:** CHI '05 extended abstracts on Human factors in computing systems  
**Publisher:** ACM

Full text available:  [pdf\(230.29 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [cited by](#), [index terms](#)

Guessability is essential for symbolic input, in which users enter gestures or keywords to indicate characters or commands, or rely on labels or icons to access features. We present a unified approach to both maximizing and evaluating the guessability ...

**Keywords:** command-line, commands, edgewrite, gestures, guessability, icons, immediate usability, keywords, labels, proposals, referents, symbols, text entry, unistrokes

### 17 Joystick text entry with date stamp, selection keyboard, and EdgeWrite

 Jacob O. Wobbrock, Brad A. Myers, Htet Htet Aung  
April 2004 **CHI '04:** CHI '04 extended abstracts on Human factors in computing systems  
**Publisher:** ACM

Full text available:  [pdf\(56.70 KB\)](#) Additional Information: [full citation](#), [references](#)


**Keywords:** EdgeWrite, game controller, joystick, text entry

### 18 Few-key text entry revisited: mnemonic gestures on four keys

Jacob Wobbrock, Brad Myers, Brandon Rothrock

 April 2006 **CHI '06**: Proceedings of the SIGCHI conference on Human Factors in computing systems

**Publisher:** ACM

Full text available:  pdf(1.08 MB)

Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

We present a new 4-key text entry method that, unlike most few-key methods, is gestural instead of selection-based. Importantly, its gestures mimic the writing of Roman letters for high learnability. We compare this new 4-key method to predominant 3-key ...

**Keywords:** EdgeWrite, date stamp, gestures, mobile devices, selection keyboard, text entry, text input, unistrokes, wearables

19 Gestures without libraries, toolkits or training: a \$1 recognizer for user interface prototypes



Jacob O. Wobbrock, Andrew D. Wilson, Yang Li

October 2007 **UIST '07**: Proceedings of the 20th annual ACM symposium on User interface software and technology

**Publisher:** ACM

Full text available:  pdf(733.38 KB)

Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Although mobile, tablet, large display, and tabletop computers increasingly present opportunities for using pen, finger, and wand gestures in user interfaces, implementing gesture recognition largely has been the privilege of pattern matching experts, ...

**Keywords:** dynamic time warping, gesture recognition, marks, rapid prototyping, recognition rates, rubine, statistical classifiers, strokes, symbols, unistrokes, user interfaces

20 In your own words: using full sentences as feedback



Jacob O. Wobbrock

April 2002 **CHI '02**: CHI '02 extended abstracts on Human factors in computing systems

**Publisher:** ACM

Full text available:  pdf(249.30 KB)

Additional Information: [full citation](#), [abstract](#), [references](#)

Many applications have cluttered dialogs that require users to make complicated settings. Some settings even determine the availability and state of other settings, creating interdependencies that can be hard to discern. Most affordances, although they ...

**Keywords:** affordance, configuration task, configuration tool, feedback, grammar, natural language, widget

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